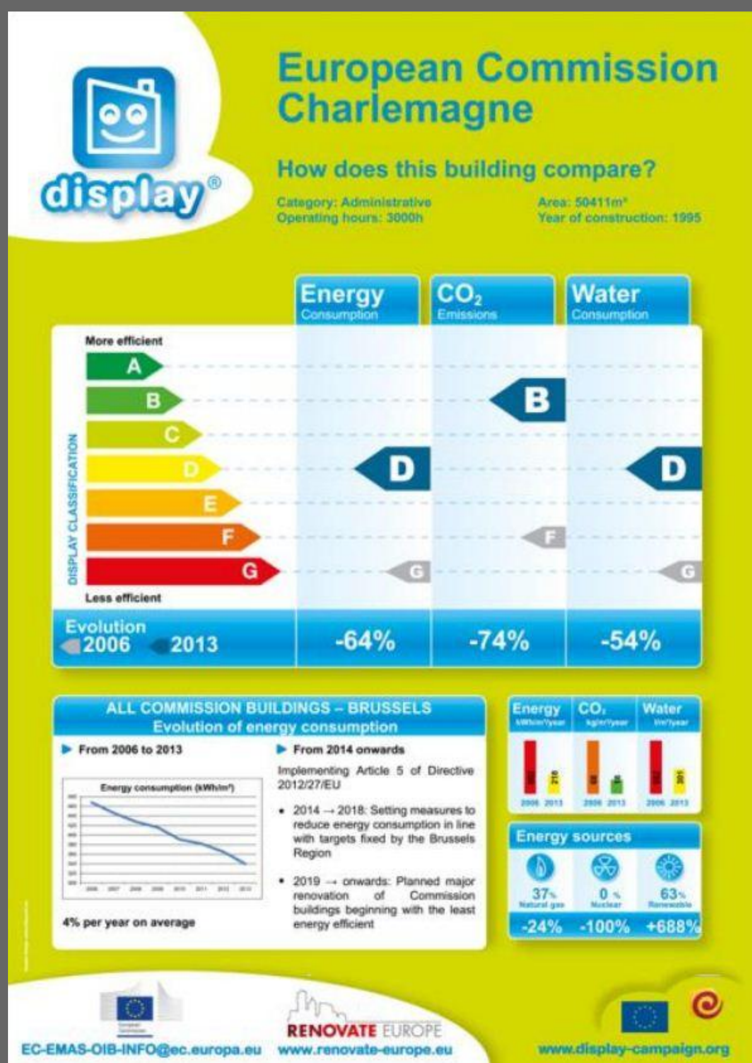
ENHANCING CAPACITY FOR LOW EMISSION DEVELOPMENT STRATEGIES (EC-LEDS) CLEAN ENERGY PROGRAM

COOPERATIVE AGREEMENT NO. 114-A-13-00008

REPORT ON ADOPTING DISPLAY® OR ENERGY PASSPORT TOOL, AND DEVELOPING GUIDELINES



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April 2015

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TABLE OF CONTENTS

Acknowledgements iii

Acronyms vi

Executive Summary 1

Section one: Analysis of the Display® Campaign Software Tool 2

1.1 Overview of the Display® Campaign background 2

1.2 Content of the Display Poster Tool 3

1.3 Display® data form sheet 10

1.4 Methodology of the Display® tool 13

1.5 Future prospects of Energy Performance labeling according to EPBD requirements 16

SECTION 2: creating an Energy Passport software tool to certify a building by asset (calculated) rating scheme developed by the SDAP Center 17

2.1 Concept of the Building Energy Passport software tool 17

2.2 Methodology used for the Building Energy Passport software 18

2.3 Calculations performed by Building Energy Passport software 20

SECTION 3: Comparison of the Display® and building energy passport software calculation tools for labeling existing and new buildings 23

3.1 Evidence based approach for the use of the Display® and "Building Energy Passport" tools for energy performance labeling 23

3.2 User guide for labeling existing buildings with the adapted Display® calculation tool 24

REFERENCES 29

ANNEX 1:Comparison of energy performance calculations for insulated and uninsulated buildings 30

LIST OF FIGURES

FIGURE 1. RESULTS OF RESEARCH ILLUSTRATING THE INCREASE IN PUBLIC AWARENESS FROM THE DISPLAY® POSTER AND COMMUNICATION CAMPAIGNS 3

FIGURE 2. THE DISPLAY® POSTER 4

FIGURE 3. DISPLAY® DATA BASE STRUCTURE 5

FIGURE 4.FLOW CHART OF DISPLAY® CALCULATION TOOL 13

FIGURE 5. PROPORTION OF RESIDENTIAL AND NON- RESIDENTIAL BUILDINGS IN EU 16

FIGURE 6. THE MAIN SOFTWARE WINDOW SHOWING CALCULATIONS FOR A RESIDENTIAL BUILDING DEVELOPED BY THE COMPANY "ARCI" 21

FIGURE 7. THERMAL BALANCE CHART WITH THE CALCULATED ENERGY PERFORMANCE CERTIFICATE SECTION 22

FIGURE 8. HEAT CONSUMPTION CALCULATED BY SOFTWARE TOOL FOR UN-INSULATED AND INSULATED PROTOTYPE BUILDINGS. 22

FIGURE 9. "POSTER EDITION "SECTION OF THE PROGRAM 25

Figure 10. Sub section for general data 25

Figure 11. Sub section for energy and water consumption data 26

Figure 12. List of registered buildings 27

Figure 13. List of calculations 28

LIST OF TABLES

Table 1. (a/.and b/.) Classification scheme for primary energy ratio for different types of buildings 6

Table 2. (a/.and b/.) Classification scheme for CO2 ratio for different types of buildings 7

Table 3. (a/.and b/.) Classification scheme for the water ratio for different types of buildings 8

Table 4. Display® classification for indoor temperatures in 0 C for different types of buildings 9

Table 5. Data on energy consumption 11

Table 6. General conversion factors 14

ACRONYMS

Acronym	Full name
CA	Concerted Action
CED	Cumulative Energy Demand
EPBD	Energy Performance of Buildings Directive
EPC	Energy Performance Certificate
GBC Georgia	Green Building Council Georgia
GHG	Greenhouse Gases
MS	Member States
SDAP Center	Sustainable Development and Policy Center

EXECUTIVE SUMMARY

This report is developed according to the subcontract agreement between the SDAP Center and the Winrock International/ EC LEDS Clean Energy Program within the framework of a task addressing the 'green building certification and rating system". The scope of the work for the SDAP Center includes advice to the Green Building Council (GBC) of Georgia with an energy performance certification scheme for the voluntary labeling of existing buildings.

To carry out this task and provide recommendations to GBC Georgia the Display® and "Energy Passport" software tools were compared. More exactly, the two labeling approaches were compared: *operational rating* generated by the Display® tool and *calculated rating* developed with the Energy Passport.

The European Display® calculation tool is a voluntary scheme set up by municipalities of the Energy Cities Association. It was designed by energy experts in 2001 to support implementation of the Directive on Energy Performance of Buildings among municipalities to display an energy performance certificate on buildings.

A key part of the rationale for developing the energy display label was to motivate decision makers to have a common approach for European certification of public building energy performance. Energy and water consumption for a given year, as well as hours of operation, service systems and the size of a building are entered into the data base which then generates an "operational rating" for energy performance, environmental performance and water consumption of the building.

The Display® calculation tool was very successful in EU countries and was used widely by energy managers to label existing public buildings. It is user-friendly software that doesn't require professional knowledge.

The "Energy Passport" software tool is used to certify new buildings. It was developed by the (SDAP) Center for professional use. This software provides an opportunity to assess an integrated building's energy performance at the building design/planning stages and takes into account factors that are usually impossible to consider for existing buildings. These include the evaluation of a compactness coefficient according to building shape, location and optimal orientation, which are important, for solar radiation and wind power; the reduction of air permeability; the integration of passive energy design elements; and other factors that are significant for reducing energy consumption without special investments.

Considering all of these elements, the SDAP Center suggested that GBC Georgia use the Display® certification tool for existing buildings, since many of the innovative factors proposed by the Building Energy Passport software tool may not be applicable for existing structures, nor would they particularly affect the labeling result.

SECTION ONE: ANALYSIS OF THE DISPLAY® CAMPAIGN SOFTWARE TOOL

1.1 OVERVIEW OF THE DISPLAY® CAMPAIGN BACKGROUND

The “Energy Cities” is an association of local authorities engaged in promotion of local sustainable energy policies. It was established in 1990 and currently includes more than 1000 cities in 28 EU countries. In light of the upcoming innovative EU legislation -- the Directive on Energy Performance of Buildings (EPBD) 2002/91/EC-- European Cities decided to create an example by publicly displaying the energy performance of public buildings. The decision aimed to meet the requirements of the Directive’s provisions that applied to energy performance certification of public buildings, but also sought to raise awareness through a campaign to promote sustainable urban development and to change behavior.

Before 2001 the “Energy Cities” Association submitted a proposal for the Display® project to the EU Commission, which was accepted subsequently when the EPBD legislation came into force. The pilot phase of the project started in January 2003 and included the joint efforts of 20 municipalities in 18 countries and technical expertise. From 2005 the EU Commission co-financed the Display® Campaign project within the Intelligent Energy Europe program.

The objective of the Display® Campaign was to provide municipalities with a tool that could be used at the local level to advance certification and implement provisions of the Directive on energy performance certification of public buildings. As a result the "Display® poster” – a calculation tool to certify buildings-- was developed, and the certification process was followed up by local communication campaigns that publicly displayed certificates for municipal buildings to help the overall process to become a catalyst to accelerate behavior change. To simplify the communication on energy performance issue for municipal buildings the Energy Cities’ Display® pilot cities and experts prepared a communications handbook.

The common principle used in the Display® poster for certification of public buildings with letters from the Latin alphabet was built on an already existing marketing campaign. This had been inspired by the system used to label household electrical appliances for public purchasing decisions. The Display® poster tool shows the certification of building by its primary energy consumption, its CO_2 emissions and water consumption. The layout of the poster is eye-catching and easy to understand, and is now available in all European languages. Today it facilitates a new way of communicating between the municipality and public by:

- presenting an innovative municipal information component,
- creating a labeling system for the building sector,
- and clearly communicating the municipality’s seriousness about sustainable energy use.

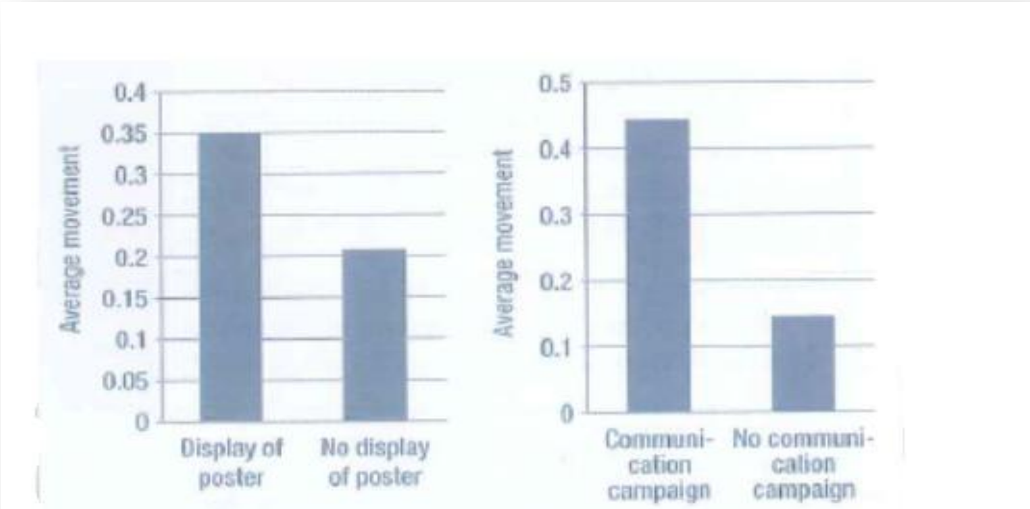
The importance and popularity of the Display® Campaign is built on the recognition that the Display® poster is just a starting point of the campaign for energy efficiency of public buildings leading towards “Class A”. The Display® poster performs three functions I is a:

- calculation tool,
- monitoring and benchmarking tool,

- and an information tool to encourage dialogue between decision makers, municipal experts and the general public.

Results of research carried out in the De Montfort University shows that the average movement in buildings showing the Display® posters with carried out communication campaigns is higher than in those when it wasn't done (Figure. 1) [1].

Figure 1. Results of research illustrating the increase in public awareness from the Display® poster and communication campaigns.



Over 500 local and regional authorities in Europe have been involved in the Display® campaign thus the project has established a substantial and unique database of participants in the 28 Member States.

Central to the nature of Display® Campaign is the ability of municipal energy managers and staff in the municipalities to enter key details of their buildings into the on-line database, and to produce their own posters.

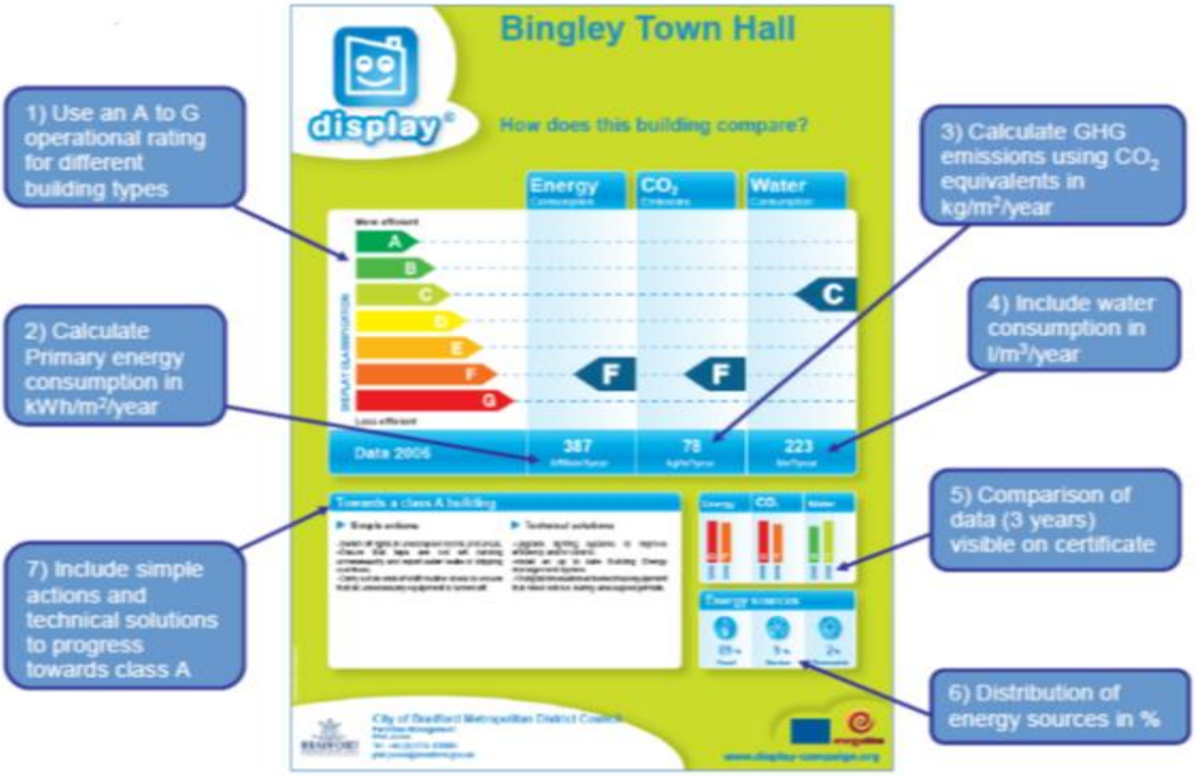
When it was being developed priority was given to making the posters easy to produce and user-friendly. This became a key factor of success in for the campaigns, since it eradicated the need for expensive assessors. The voluntary process of certification/labeling was built on efforts by motivated municipalities that took the time to collect data, shared their experience from this process, and learned from these lessons. Thus when a more comprehensive common certification system is introduced by the EU Commission there will already be an existing body of understanding and support. More than 13,000 EU buildings have been labeled with the Display® poster showing their energy and water consumption and GHG emissions.

The use of operational data is particularly appropriate for public buildings to improve performance since they are less influenced by the market and more by management. The Display® poster is easily understood, including a section where the Municipality communicates how they aim to improve the building's classification.

1.2 CONTENT OF THE DISPLAY POSTER TOOL

Development of the Display® poster software tool became a main factor that determined its use to certify public buildings among the Member States. The layout design resulted from the work of many participating groups, including energy managers and communication experts. Seven technical points of the Display® poster layout design are illustrated in Fig. 2:

Figure 2. The Display® poster

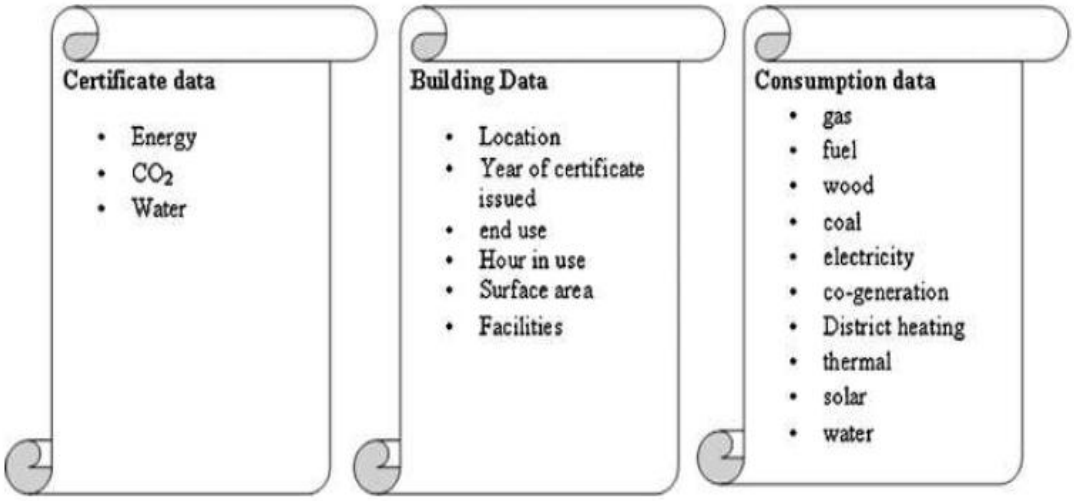


1. Data for different building types can be included for A-G operational rating certification;
2. Calculation of primary energy consumption in kWh/m^2/year;
3. Calculation of the GHG emissions using the CO_2equivalent in kg/m^2/year;
4. Inclusion of water consumption in l/m^2/year;
5. Comparison of three-year data visible on certificate;
6. Distribution of energy sources in %;
7. Inclusion of simple actions and technical solutions to progress towards class A.

The Display® tool database structure illustrated in Figure 3 covers important parameters of building characteristics grouped by:

- energy certificates data;
- general building data;
- annual summary of energy consumption data.

Figure 3. Display® data base structure



The data is enclosed in a comma- separated value csv format that allows it to be easily imported into Microsoft Excel spreadsheets. Further data is analyzed using structured query language (SQL) Server, which is a free database software that works well with other web applications for requesting information from a database.

The Danish classification scheme has been used since 1996 and takes into account a building typology that constitutes the basis of the Display® classification schemes[1]. With the increasing number of different types of registered buildings in the data base and use of an iterative approach, classification schemes were adjusted to the program as the software was developed. Tables 1-3 illustrate the distribution of the numerical values for primary energy, CO_2 emissions and water consumption in the "6 classes" classification system used in the Display® tool for different types of buildings.

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[1] http://www.display-campaign.org/doc/en/index.php/APPENDICES#The_Classification_Scheme

Table 1. (a/.and b/.) Classification scheme for primary energy ratio for different types of buildings

a/.

kWh/(m². yr)	1/ Day nursery / Kindergarten	2/ General school	3/ Professional school	4/ Administration	5/ Swimming pool	6/ Sports facilities	7/ Depot	8/ Meeting places
A	X ≤ 75	X ≤ 50	X ≤ 75	X ≤ 75	X ≤ 500	X ≤ 75	X ≤ 75	X ≤ 75
B	75 < X ≤ 140	50 < X ≤ 100	75 < X ≤ 125	75 < X ≤ 140	500 < X ≤ 2000	75 < X ≤ 150	75 < X ≤ 160	75 < X ≤ 160
C	140 < X ≤ 205	100 < X ≤ 150	125 < X ≤ 175	140 < X ≤ 205	2000 < X ≤ 3500	150 < X ≤ 225	160 < X ≤ 245	160 < X ≤ 245
D	205 < X ≤ 270	150 < X ≤ 200	175 < X ≤ 225	205 < X ≤ 270	3500 < X ≤ 5000	225 < X ≤ 300	245 < X ≤ 330	245 < X ≤ 330
E	270 < X ≤ 335	200 < X ≤ 250	225 < X ≤ 275	270 < X ≤ 335	5000 < X ≤ 6500	300 < X ≤ 375	330 < X ≤ 415	330 < X ≤ 415
F	335 < X ≤ 400	250 < X ≤ 300	275 < X ≤ 325	335 < X ≤ 400	6500 < X ≤ 8000	375 < X ≤ 420	415 < X ≤ 500	415 < X ≤ 500
G	X > 400	X > 300	X > 325	X > 400	X > 8000	X > 450	X > 500	X > 500

b/.

kWh/(m² . yr)	9) Health Centre	10) Rescue Centre	11) Multi residential	12) Individual House	13) Commercial	14) Restaurant	15) Industrial	16) Hospital
A	X ≤ 150	X ≤ 100	X ≤ 50	X ≤ 50	X ≤ 75	X ≤ 125	X ≤ 50	X ≤ 175
B	150 < X ≤ 225	100 < X ≤ 200	50 < X ≤ 100	50 < X ≤ 110	75 < X ≤ 145	125 < X ≤ 245	50 < X ≤ 100	175 < X ≤ 300
C	225 < X ≤ 300	200 < X ≤ 300	100 < X ≤ 150	110 < X ≤ 170	145 < X ≤ 215	245 < X ≤ 365	100 < X ≤ 150	300 < X ≤ 425
D	300 < X ≤ 375	300 < X ≤ 400	150 < X ≤ 200	170 < X ≤ 230	215 < X ≤ 285	365 < X ≤ 485	150 < X ≤ 200	425 < X ≤ 550
E	375 < X ≤ 450	400 < X ≤ 500	200 < X ≤ 250	230 < X ≤ 290	285 < X ≤ 355	485 < X ≤ 605	200 < X ≤ 250	550 < X ≤ 675

F	450 < X ≤ 525	500 < X ≤ 600	250 < X ≤ 300	290 < X ≤ 350	355 < X ≤ 425	605 < X ≤ 725	250 < X ≤ 300	675 < X ≤ 800
G	X > 525	X > 600	X > 300	X > 350	X >425	X > 725	X > 300	X > 800

Table 2. (a/.and b/.) Classification scheme for CO2 ratio for different types of buildings

a/.

Kg//(m² . yr)	1/ Day nursery / Kindergarten	2/ General school	3/ Professional school	4/ Administration	5/ Swimming pool	6/ Sports facilities	7/ Depot	8/ Meeting places
A	X ≤ 15	X ≤ 10	X ≤ 15	X ≤ 15	X ≤ 100	X ≤ 15	X ≤ 15	X ≤ 15
B	15 < X ≤ 28	10 < X ≤ 20	15 < X ≤ 25	15 < X ≤ 28	100 < X ≤ 400	15 < X ≤ 30	15 < X ≤ 32	15 < X ≤ 32
C	28 < X ≤ 41	20 < X ≤ 30	25 < X ≤ 35	28 < X ≤ 41	400 < X ≤ 700	30 < X ≤ 45	32 < X ≤ 49	32 < X ≤ 49
D	41 < X ≤ 54	30 < X ≤ 40	35 < X ≤ 45	41 < X ≤ 54	700 < X ≤ 1000	45 < X ≤ 60	49 < X ≤ 66	49 < X ≤ 66
E	54 < X ≤ 67	40 < X ≤ 50	45 < X ≤ 55	54 < X ≤ 67	1000 < X ≤ 1300	60 < X ≤ 75	66 < X ≤ 83	66 < X ≤ 83
F	67 < X ≤ 80	50 < X ≤ 60	55 < X ≤ 65	67 < X ≤ 80	1300 < X ≤ 1600	75 < X ≤ 90	83 < X ≤ 100	83 < X ≤ 100
G	X > 80	X > 60	X > 65	X > 80	X > 1600	X > 90	X > 100	X > 100

b/.

kg/(m² . yr)	9) Health Centre	10) Rescue Centre	11) Multi residential	12) Individual House	13) Commercial	14) Restaurant	15) Industrial	16) Hospital
A	X ≤ 30	X ≤ 20	X ≤ 10	X ≤ 10	X ≤ 15	X ≤ 25	X ≤ 10	X ≤ 35
B	30 < X ≤ 45	20 < X ≤ 36	10 < X ≤ 20	10 < X ≤ 22	15 < X ≤ 29	25 < X ≤ 49	10 < X ≤ 20	35 < X ≤ 60
C	45 < X ≤ 60	36 < X ≤ 52	20 < X ≤ 30	22 < X ≤ 34	29 < X ≤ 43	49 < X ≤ 73	20 < X ≤ 30	60 < X ≤ 85

D	60 < X ≤ 75	52 < X ≤ 68	30 < X ≤ 40	34 < X ≤ 46	43< X ≤ 57	73 < X ≤ 97	30 < X ≤ 40	85 < X ≤ 110
E	75 < X ≤ 90	68 < X ≤ 86	40 < X ≤ 50	46 < X ≤ 58	57 < X ≤ 71	97 < X ≤ 121	40 < X ≤ 50	110 < X ≤ 135
F	90 < X ≤ 105	86 < X ≤ 102	50 < X ≤ 60	58 < X ≤ 70	71 < X ≤ 85	121 < X ≤ 145	50 < X ≤ 60	135 < X ≤ 160
G	X > 105	X > 102	X > 60	X > 70	X > 85	X > 145	X > 60	X > 160

Table 3. (a/.and b/.) Classification scheme for the water ratio for different types of buildings

a/.

L/(m².yr)	1/ Day nursery / Kindergarten	2/ General school	3/ Professional school	4/ Administration	5/ Swimming pool	6/ Sports facilities	7/ Depot	8/ Meeting places
A	X ≤ 50	X ≤ 60	X ≤ 50	X ≤ 30	X ≤ 80	X ≤ 40	X ≤ 30	X ≤ 30
B	50 < X ≤ 250	60 < X ≤ 150	50 < X ≤ 145	30 < X ≤ 170	80 < X ≤ 125	40 < X ≤ 110	30 < X ≤ 110	30 < X ≤ 100
C	250 < X ≤ 450	150 < X ≤ 240	145 < X ≤ 240	170 < X ≤ 240	125 < X ≤ 170	110 < X ≤ 180	110 < X ≤ 190	100 < X ≤ 170
D	450 < X ≤ 650	240 < X ≤ 330	240 < X ≤ 335	240 < X ≤ 310	170 < X ≤ 215	180 < X ≤ 250	190 < X ≤ 270	170 < X ≤ 240
E	650 < X ≤ 850	330 < X ≤ 420	335 < X ≤ 430	310 < X ≤ 380	215 < X ≤ 260	250 < X ≤ 320	270 < X ≤ 350	240 < X ≤ 310
F	850 < X ≤ 1050	420 < X ≤ 510	430 < X ≤ 525	380 < X ≤ 450	260 < X ≤ 305	320 < X ≤ 390	350 < X ≤ 430	310 < X ≤ 380
G	X > 1050	X > 510	X > 525	X > 450	X > 305	X > 390	X > 430	X > 380

b/

L/(m².yr)	9) Health Centre	10) Rescue Centre	11) Multi residential	12) Individual House	13) Commercial	14) Restaurant	15) Industrial	16) Hospital
A	X ≤ 80	X ≤ 350	X ≤ 300	X ≤ 500	X ≤ 100	X ≤ 500	X ≤ 350	X ≤ 500
B	80 < X ≤ 510	350 < X ≤ 500	300 < X ≤ 550	500 < X ≤ 800	100 < X ≤ 200	500 < X ≤ 750	350 < X ≤ 480	500 < X ≤ 750

C	510 < X ≤ 940	500 < X ≤ 650	550 < X ≤ 800	800 < X ≤ 1100	200 < X ≤ 300	750 < X ≤ 1000	480 < X ≤ 610	750 < X ≤ 1000
D	940 < X ≤ 1380	650 < X ≤ 800	800 < X ≤ 1050	1100 < X ≤ 1400	300 < X ≤ 400	1000 < X ≤ 1250	610 < x ≤ 740	1000 < x ≤ 1250
E	1380 < X ≤ 1810	800 < X ≤ 950	1050 < X ≤ 1300	1400 < X ≤ 1700	400 < X ≤ 500	1250 < X ≤ 1500	740 < X ≤ 870	1250 < X ≤ 1500
F	1810 < X ≤ 2240	950 < X ≤ 1100	1300 < X ≤ 1550	1700 < X ≤ 2000	500 < X ≤ 600	1500 < X ≤ 1750	870 < X ≤ 1000	1500 < X ≤ 1750
G	X > 2240	X > 1100	X > 1550	X > 2000	X > 600	X > 1750	X > 1000	X > 1750

The Display® classification scheme used in the software tool also classifies indoor climatic conditions for different types of buildings by the numerical values illustrated in Table 4.

Table 4. Display® classification for indoor temperatures in 0 C for different types of buildings

L/(m². yr)	**Building type 1/2/3/4/8/9/ 11/12**	**Building type 6/13/15**	**Building type 10/16**	**Building type 5**	**Building Type 14**
A	19° ≤ X< 20°	17,5° ≤ X< 18,5°	21,5° ≤ X< 22,5°	27,5° ≤ X< 28,5°	20,5° ≤ X< 21,5°
B	18,5° ≤ X < 19,0° or 20,0° ≤ X< 21,0°	17,0° ≤ X < 17,5° or 18,5° ≤ X< 19,5°	21,0° ≤ X < 21,5° or 22,5° ≤ X< 23,5°	27,0° ≤ X < 27,5° or 28,5° ≤ X< 29,5°	20,0° ≤ X < 20,5° or 21,5° ≤ X< 22,5°
C	18,0° ≤ X < 18,5° or 21,0° ≤ X< 22,0°	16,5° ≤ X < 17,0° or 19,5° ≤ X< 20,5°	20,5° ≤ X < 21,0° or 23,5° ≤ X< 24,5°	26,5° ≤ X < 27,0° or 29,5° < X ≤ 30,5°	19,5° ≤ X < 20,0° or 22,5° < X ≤ 23,5°
D	17,5° ≤ X <18,0° or 22,0° ≤ X< 23,0°	16,0° ≤ X < 16,5° or 20,5° ≤ X< 21,5°	20,0° ≤ X < 20,5° or 24,5° ≤ X< 25,5°	26,0° ≤ X <27,5° or 30,5° < X ≤ 31,5°	19,0° ≤ X 19,5° or 23,5° < X ≤ 24,5°
E	17,0° ≤ X <17,5° or 23,0° ≤ X< 24,0°	15,5° ≤ X < 16,0° or 21,5° ≤ X< 22,5°	19,5° ≤ X < 20,0° or 25,5° ≤ X< 26,5°	25,5° ≤ X <26,0° or 31,5° < X ≤ 32,5°	18,5° ≤ X < 19,0° or 24,5° < X ≤ 25,5°
F	16,5° ≤ X <17,0° or 24,0° ≤ X< 25,0°	15,0° ≤ X < 15,5° or 22,5° ≤ X< 23,5°	19,0° ≤ X < 19,5° or 26,5° ≤ X< 27,5°	25,0° ≤ X <25,5° or 32,5° < X ≤ 33,5°	18,0° ≤ X < 18,5° or 25,5° < X ≤ 26,5°
G	16,0° < X > 25,0°	15,0° < X > 23,5°	19,0° < X > 27,5°	25,0° < X > 33,5°	18,0° < X > 26,5°

1.3 DISPLAY® DATA FORM SHEET

The data information that should be entered in the Display® tool to generate a poster for the database presented in Figure 3 covers the following issues:

1. Name of building;

1a Year of construction;

1b Level of refurbishment (high, medium, low);

2. Building category:
   - *Day nursery / Kindergarten*
   - *General school*
   - *Professional school*
   - *Administrative*
   - *Swimming pool*
   - *Sport facilities*
   - *Depot*
   - *Meeting places*
   - *Health center*
   - *Rescue center*
   - *Multi-residential*
   - *Individual house*
   - *Commercial*
   - *Restaurant*
   - *Industrial*
   - *Hospital*
3. Area (m ^{2});
4. Operating hours (hours/year);
5. Services provided in the building:
   - Catering services
   - Commercial
   - Industrial premises
   - Sport facilities
   - Apartment
   - Kindergarten

- Swimming pool

6. Swimming pool water surface (m ²);

Calculation section

7. Reference year;
8. Weather correction factor;
9. Water consumption (for swimming pools-- number of swimmers per year);
10. Energy consumption data (according to Table 5)
11. Information on district heating (if used)

Table 5. Data on energy consumption

Energy sources	Unit	Space Heating	Cooling	Water heating	Others	Total
Gas**	[kWh]					
Fuel oil	[kWh]					
Coal	[kWh]					
District Heating	[MWh]					
Wood	[kWh]					
Solar heating	[kWh]					
Electricity (conventional)	[kWh]					
Electricity (green)	kWh]					
Photovoltaic	kWh]					

**Specify types of energy sources used

Gas:

◻Natural gas ◻ Liquefied gas ◻ Biogas (also gas from a water treatment plant and dump)

<u>Coal:</u> ◻ Anthracite ◻ Brown coal <u>Wood</u>: ◻ Logs ◻ Chips ◻ Pellets

Energy sources used for district heating: Fossil fuels with waste incineration (i.e. Gas, Fuel oil, Waste incineration, Anthracite, Brown coal) …………%   Renewables with waste heat (i.e. Biomass, Solar, Geothermal)…………………% District heat coming from a cogeneration plant Cogeneration Plant ◻ Yes ◻ No Individual specification of district heating network Cumulative energy use factor………………………………………........................... kWh/kWh CO_2 emission factor……………………………………………………………............. kg/kWh

11. Distribution of *consumed conventional electricity*, if known and different from the national one

Fossil: ………………………………………………………………………………………………. % (Gas, fuel oil, coal, waste incineration) Nuclear: ……………………………………………………………………………………………..% Renewable: ………………………………………………………………………………………% (Hydro-electric, wind, biomass, solar energy) Cumulative energy use factor……………………………………………..................….kWh/kWh CO_2 emission factor…………………………………………………………………......…kg/kWh

12. Cogeneration unit

Energy source used: * Natural gas * Fuel oil * Biogas Overall electricity produced: ....kWh Of which… is fed into the grid: ....kWh

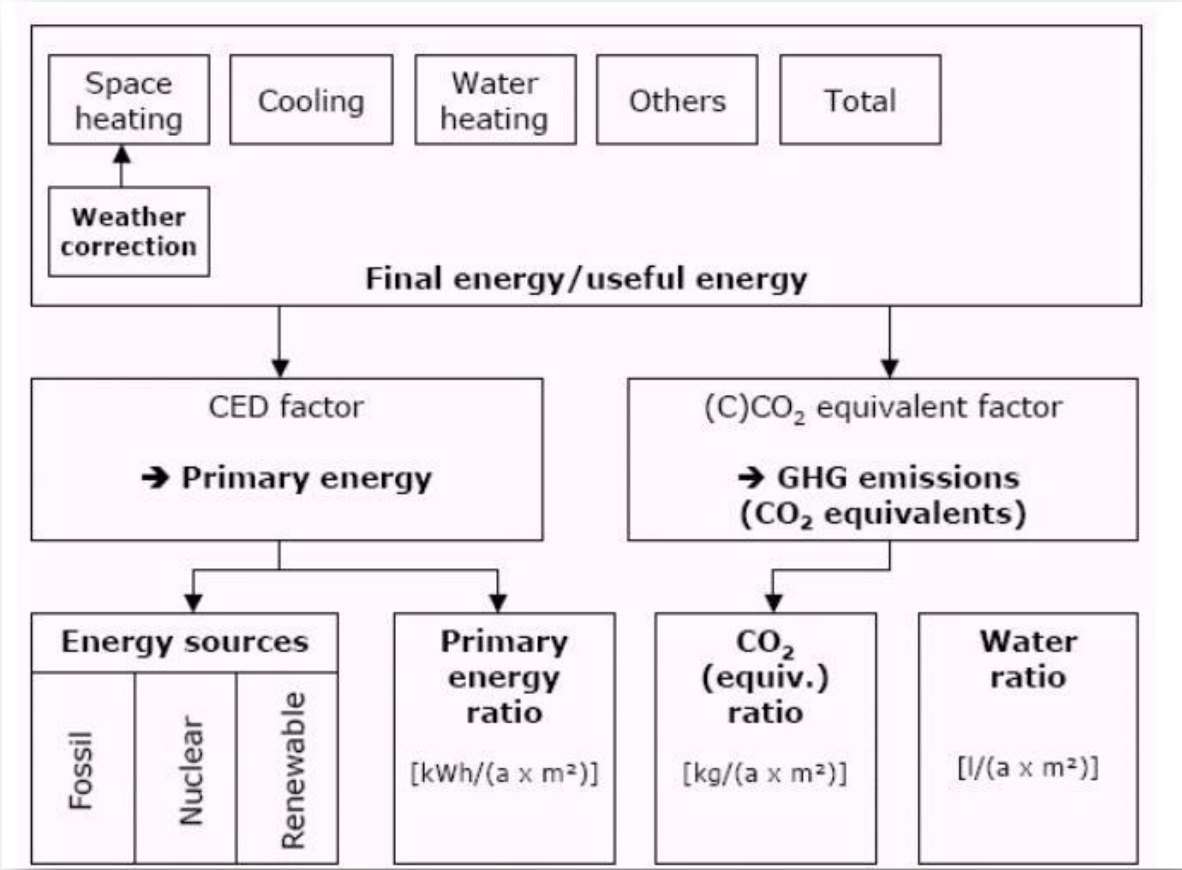
13. Information on *Simple Actions* to improve the environmental or energy performance of the building
14. Information on *Technical Solutions* to improve the environmental or energy performance of the building.

1.4 METHODOLOGY OF THE DISPLAY® TOOL

The energy consumption that is correlated to the building's energy consuming systems creates the foundation for the Display® calculation tool, which is presented in Fig. 4 with conversion factors in the form of a flow chart.

Final energy consumption data is entered into the software, and the program calculates energy in the form of equivalent primary energy consumption. Thus the cumulative energy consumption factors are used to account the primary energy consumption. This constitutes the amount of energy consumed including all production chains such as extraction, transportation and transformation[2].

Figure 4.Flow chart of Display® calculation tool



CED is the "cumulative energy demand" factor defined in the German guidelines VDI 4600 that includes the amount of primary energy used according to the type of materials, and is reflected in the lower heating value of the product. The Display® calculation instrument uses conversion factors based on the German database GEMIS. Conversion factors for energy sources such as gas, fuel oil and coal are used from GEMIS Version 4 as are conversion factors for district heating.

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[2]The abbreviation for cumulative energy use factors isn't widely used in English, so the German abbreviation KEV is used in the Display® poster user guide.

However, conversion factors for wood, production of hot water by solar thermal collector and the generation of photovoltaic electricity in buildings are taken from the ProBas database, also used to provide most of the factors for national electricity mixes. The ProBas database contains more than a 7,000-unit process database used for diversity of life cycle management scenarios, and to develop a life cycle analysis.

Different system boundaries for conversion factors are used for gas, fuel oil, and coal. The system boundary of buildings is envisaged as the transfer point, including the heat generator. The conversion factors for wood do not include transport or the heat generator. For electricity, conversion factors include only the generation of electricity but they do not take into account transmission and transformation processes. In the case of solar energy collectors, the conversion factor takes into account the energy input up to the transfer point of heat at the outlet of the device, however further devices necessary to run the heating system are not included.[3] The general conversion factor values used in the Display® calculation tool are presented in Table 6.

Table 6. General conversion factors

Energy or energy source	Type of conversion	Conversion factor	Unit
	MWh to kWh	1000	kWh/MWh
	kWh to MWh	0,001	MWh/kWh
wood *(1)*	kg to kWh	5,5	kWh/kg
anthracite	kg to kWh	8,6	kWh/kg
brown coal	kg to kWh	5,4	kWh/kg
fuel oil (light)	l to kWh	10,0	kWh/l
natural gas	M3 to kWh	10,1	kWh/m3
natural gas[4]	UHV to LHV	0,9	
biogas	m3 to kWh	6,0	kWh/m3
liquefied gas	m3 to kWh	26,0	kWh/m3
liquefied gas	kg to kWh	12,9	kWh/kg

[3] http://www.display-campaign.org/doc/en/index.php/THE_DISPLAY%C2%AE_METHODOLOGY

[4] Ultra-high vacuum (UHV) is the vacuum regime characterized by pressure lower than about 10^{-7} Pascal.

liquefied gas	UHV to LHV	0,9	

The system boundaries used to describe energy consumption are also used for the CO_2 emission factors that actually constitute the sum of all CO_2 emissions from different sources of energy.

The Display® calculation tool concept is built on an understanding of the harmonized use of the calculation tool across EU regions, under different climatic conditions, which means that for appropriate use of the Display® calculation tool it needs to be adapted to local climatic conditions. To ensure the success of the program this software was adapted to all local climatic conditions of the EU Member States. In recent years, the Energy Efficiency Center of Georgia collaborated with the Energy Cities Association to adapt the calculation tool, resulting in an adaption of the online software for Georgian climatic conditions and in the Georgian language.

The program allows a comparison of results for the same building in different years, and presents them on the poster layout, taking into account the weather correction factor. Thus the weather correction factor should be multiplied by the final heating energy consumption of the corresponding energy source, then multiplied by its specific CED factor. This calculation permits the result to be presented in the form of primary energy consumption.

It is expected that the temperature correlation for energy consumption will provide a basis for decision makers in carrying out sustainable urban energy policy oriented towards technical and behavior improvements by avoiding errors associated with the weather factor.

In order to implement a weather correction factor for final energy consumption, the following elements must be known:

- Actual final energy consumption (available from bills or energy meter);
- The share of energy used for space heating;
- The number of heating degree-days.

The following method is used to calculate the heating degree-days (HDD):

$$\mathbf{HDD= (18°C - Tm) \times d} \qquad \mathbf{(1)}$$

Where:

Tm-is an outdoor temperature that is lower or equal to 15°C (for heating, **Tm=15** is taken as a temperature threshold). **Tm** is the mean (**Tmin** + **Tmax**/ 2) outdoor temperature over the duration of a heating period;

d– is the duration of a heating period in days.

The Display® calculation tool defines primary energy, carbon dioxide equivalents and water consumption performance indicators using the *operational (measured) rating scheme*. By entering all the requested input data--such as the area of the building, the expected refurbishment level, operational hours and annual energy consumption as well as energy sources used in the buildings taking into account all correlations,--the poster generation tool calculates primary energy consumption. Subsequently it calculates the specific energy consumption as a primary energy ratio – the energy consumption per m2 of the internal gross floor area of the building. Then the building is graded according to its type, by the “seven classes” values schema presented in Table 1.

Correlated to primary energy consumption, the calculation tool computes the CO_2 ratio from released emissions from energy sources in the form of kg of CO_2 emissions equivalents per m2. This ratio is used to grade buildings into "seven classes" for CO_2 emissions (Table 2). The water ratio is calculated from water consumption in the building in liters, divided by m2 of the internal gross floor area. The above ratio is used as a performance indicator for grading buildings by classification scheme values presented in Table 3 according to building typology.

The Display® calculation tool is user-friendly software designed for European cities that are members of the Display® Campaign, aiming to support energy managers' implementation of the provisions of the Energy Performance of Buildings Directive (EPBD) to improve energy performance and labeling of public buildings.

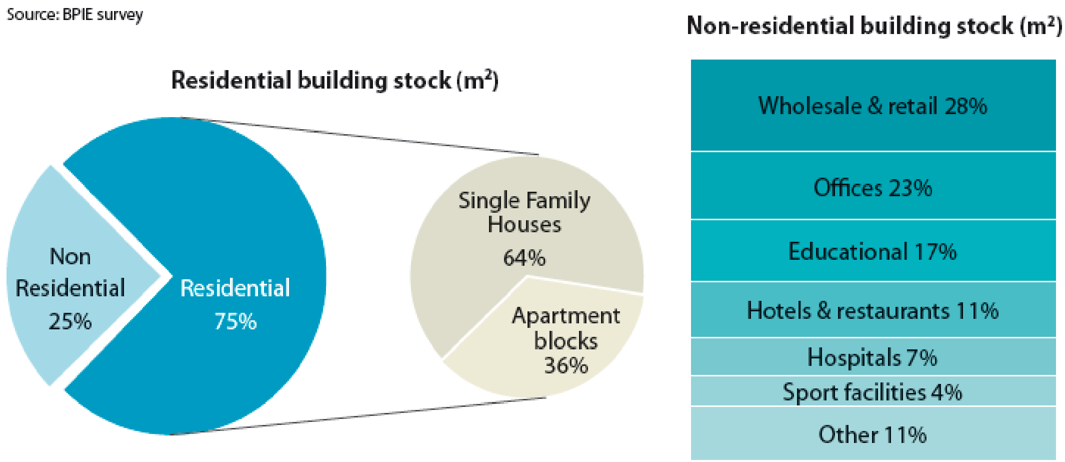
1.5 FUTURE PROSPECTS OF ENERGY PERFORMANCE LABELING ACCORDING TO EPBD REQUIREMENTS

In the EU, non-residential buildings account for 25% of total buildings and public buildings constitute about 11% of the total. The proportions of residential to non-residential buildings in the EU are shown in Figure 5[5].

Reducing energy consumption in the building sector requires the deployment of effective policies that will affect decision-making for the implementation of energy efficiency and the reduction of GHG emissions within the framework of the 2010/31/EU EPBD (recast) provisions.

In the context of these provisions, the Display® Campaign continues to play a significant role in policy-making and increasing public awareness for energy efficiency by displaying the energy performance certificates (EPC) in public buildings.

Figure 5. Proportion of residential and non- residential buildings in EU



Over the years this campaign has demonstrated successful examples of the certification of public buildings with the Display® posters providing an opportunity for the main stakeholders such as energy managers and the general public to better understand their mission and the overall certification/ labeling process in which they are indispensable players.

[5] www.institutebe.com/.../Existing%20**Building**%20Retrofits/**Europe**s-**Buil**...

By interpreting results of the certification/labeling of buildings the EU Commission stresses the importance of the EPBD requirement within the ongoing implementation of the Directive to display EPC as a property advertising instrument, to influence decision making by buyers, renters and the general public.

Experience gained by the Display® Campaign has generated a visible and positive impact in the EU Member States, and will further contribute to the implementation of the EPBD tasks, since its poster calculation tool became a common voluntary certification scheme for public buildings among the Member States.

The EU Commission has initiated a new voluntary common certification scheme for non-residential buildings and Nearly Zero Energy Buildings (NZEB). This activity is being supported by the EU commission by developing a methodology and CEN standards. Member States will likely have to develop National Plans to increase the number of NZEB.

Member States have to ensure that:

- After 31 December 2018 new buildings occupied or owned by public authorities have to be NZEB;
- After 31 December 2020 all new occupied buildings have to be NZEB.

SECTION 2: CREATING AN ENERGY PASSPORT SOFTWARE TOOL TO CERTIFY A BUILDING BY ASSET (CALCULATED) RATING SCHEME DEVELOPED BY THE SDAP CENTER

2.1 CONCEPT OF THE BUILDING ENERGY PASSPORT SOFTWARE TOOL

The overall strategic vision for building energy efficiency is to fill the gap between supply and demand in terms of building sector's energy balance, to reduce energy consumption and associated CO_2 emissions and ensuring energy efficiency while meeting evolving energy needs.

The sustainability approach for the building sector envisages reductions of negative impacts on the environment without compromising an internal level of comfort. One of the main goals of the advanced energy performance design is to reduce energy consumption in buildings.

During recent years, research on building energy efficiency has led to a broad understanding of heat consumption in buildings, and has permitted the development of strategies and technologies for energy savings. The most salient tool that should be used for designing a building's energy performance is one which assesses annual energy consumption.

The main aim in the application of a software tool for energy efficient design is to achieve the optimal balance between all factors that help minimize energy consumption. This approach enables engineers to examine energy consumption at the planning and design stage. An evaluation of energy performance design should be supplemented by reliable economic calculations. This leads to an integrated energy performance of the building envelope and cost optimal levels of energy efficiency. However software tools are usually not employed by designers and developers as they are either not accessible or there is a lack of information on building energy consumption during the design stage.

The Building Energy Passport software tool was developed by the Sustainable Development and Policy (SDAP) Center to support developers and construction companies in Georgia to apply the integrated energy performance design approach in light of the EPBD requirements. The BEP tool can assess building energy performance and analyze its energy efficiency level at the planning and design stages [2]. This is a business opportunity for Georgian companies, as it enables management to analyze the integrated level of energy performance by carrying out a cost benefit analysis, which can influence important decisions. This assessment is carried out by linking energy costs of the saved amount of energy with investment costs, ensuring the validity of energy efficiency design by verifying cost optimal levels. Such approaches could contribute to energy efficiency and the inclusion of energy efficiency in companies' development strategies by incorporating EE indicators and calculated ratings of an energy performance certificate (EPC) in property advertising.[6]

From the physics and engineering perspectives, a building represents a single thermal unit with a vital relationship between heat consumption and the building envelope's thermal performance level. This should be considered exclusively in the context of local climatic conditions.

Four key principles should be considered when designing buildings for energy performance:

- selection of geometric shape for the building that reduces heat losses; design approach that aims to lower the exterior surface area-to-volume ratio;
- reduction of energy consumption demand by increasing the energy performance level with reduction of air permeability;
- provision of required air exchange with the help of organized air intake;
- meeting energy consumption needs of the building for heating purposes in the most effective manner.

The Building Energy Passport software tool enables professionals such as building physicists, architects and engineers to use an integrated design approach to assess energy performance by identifying the interaction of building envelope choices with other systems when planning and designing a project.

This program provides flexibility for achieving optimal thermal resistance values for exterior components and the calculation of a specific consumption value based on the energy requirements of the whole building. It allows a variety of options for individual elements, using a normative/recommended value as a benchmark for comparison. The selected thermal performance (design) level enables labeling/certification by an energy consumption calculated rating system and provides figures that can be used to estimate energy savings and associated reductions of CO_2 emissions.

2.2 METHODOLOGY USED FOR THE BUILDING ENERGY PASSPORT SOFTWARE

An integrated approach to enhance building thermal performance combines upgraded thermal resistance values – R- for thermal properties of all exterior components of the building, which provides the basic level for reducing heat consumption concerning the thermal limits of air exchange

[6] Today Georgia does not have energy efficiency codes for buildings, however they are expected to be developed in the foreseeable future.

and permeability. This approach enables designers to control important indicators of energy performance at the design stage.

The "Energy Passport" software tool is a technique developed to reflect this energy performance design approach. The software was based on a methodology that lays the foundation for the "advanced systemic approach" for energy-saving building design and takes an integrated approach—rather than consider separate components that affect the heat balance of the building (walls, floors, ceilings, windows, etc) it calculates the energy performance of the building as a whole.

Energy performance is calculated as a function of envelope performance, building design and geometry. It includes the design and selection of heating and ventilation systems and passive solar systems that relate to the building orientation and to the favorable volumetric-planning design. It includes local climatic parameters. Based on this systemic approach the software tool calculates the global energy consumption of the whole building over the heating season, indicating the heating system load for the heating season.

This methodology uses calculations of heating degree-days—DD-- by Equation (2) below:

$$\mathbf{DD = (t_{in} - t_{hs}) x\ Z_{h} \qquad (2)}$$

Where: $\mathbf{t_{in}}$ - the indoor temperature °C;

$\mathbf{t_{h.s}}$ - the average temperature of heating season;

$\mathbf{Z_{hs}}$ - duration of heating season.

The normative/recommended thermal resistance values for exterior components of the building are calculated by correlating results between DD and thermal resistance values of the building envelope components. The methodology reflects the integrated approach to energy performance design by setting up normative/ recommended specific energy consumption values according to the type of building and number of storeys. This parameter is proposed as the amount of heat required during the heating season per m3 of volume of building per DD, measured in KJ/(m^3.°C.day). In each particular case the normative/recommended specific energy consumption value is adjusted since it takes into consideration the efficiency of the heat distribution system.

The overall demand in energy/heat consumption for a heating period is predicted by calculating the thermal balance components. It is calculated as a function of conductive heat losses, losses via air exchange, domestic and solar radiation intakes, by the efficiency of automatically regulated heat supply, and by a coefficient that considers additional heat consumption by the heating system.

In turn, conductive heat losses –Qt-- are calculated as a function of degree-days, building envelope area and coefficient of heat transfer. Infiltration heat losses – Qv-- are calculated as a function of degree-days, building envelope area and conventional factors of heat transfer through infiltration and ventilation. Heat intake through solar radiation --Qs-- is calculated as a function of window area, passive solar intake over cardinal points of the building, and coefficient of relative penetration of solar radiation through windows as well as a coefficient that considers shading of windows with opaque elements. Domestic heat intake – Qi-- is calculated as metabolic heat per m2, the duration of the heating season and rated heated areas of the building.

The normative / recommended specific energy consumption value is the benchmark for the design process and is very informative for its comparison with the specific consumption value that results from the design process, which seeks solutions and insulation materials for exterior components.

The Energy Passport software is a stand-alone desktop application based on Microsoft .NET Framework 4.0.

Input data includes Climate Data and Building Data. Every input has a real-time impact on the results. The software is able to save and load the data as a project file (*.epp), a climate data file (*.stm) and a building data file (*.bld). This software is also able to generate reports in Microsoft Word (Microsoft Office is required for operation). The Climate window includes climate data. The gray boxes on the right are designed for read-only; these values should be updated according to the user's input in other sections. The Energy Passport software - building window includes input boxes for the building data grouped by subject. The first tab groups the general data of the building, and the second groups the building geometry data (Area, Volume and Exposure). The third tab groups the design data of the building as well as coefficients attributed to heating system energy efficiency

Based on the methodology every input has its own purpose for the calculations, and in particular circumstances it may or may not affect the result. The software calculates and several intermediate values, which reflect the design of the energy performance of the building envelope and the certification of the building, and the creation of the energy performance certificate (EPC). Certification is developed by a energy consumption rating criterion that considers the value of the energy consumption of the building designed for the heating season. The software creates a chart of the thermal balance components.

The software works step by step to calculate in the following sequence: Climatic data such as designed outdoor temperature; average outdoor temperature during the heating season with the internal temperature relevant to the type of the building; duration of the heating period and solar radiation income on each side of the building according to its orientation and geometric parameters entered into the program; and heating DD are calculated. For a given category of energy efficiency (A, B, C) the normative/recommended specific energy consumption value is determined according to the type of building being designed. Other building indicators are calculated such as the ratio of window and balcony door areas to the total wall area, and selected coefficients of window shading. The software possesses energy "design" windows to enter heat supply coefficients heat distribution efficiency, regulation efficiency, and metabolic heat released from people in the building. When all the building design data parameters are fed in, the software performs the calculations.

2.3 CALCULATIONS PERFORMED BY BUILDING ENERGY PASSPORT SOFTWARE

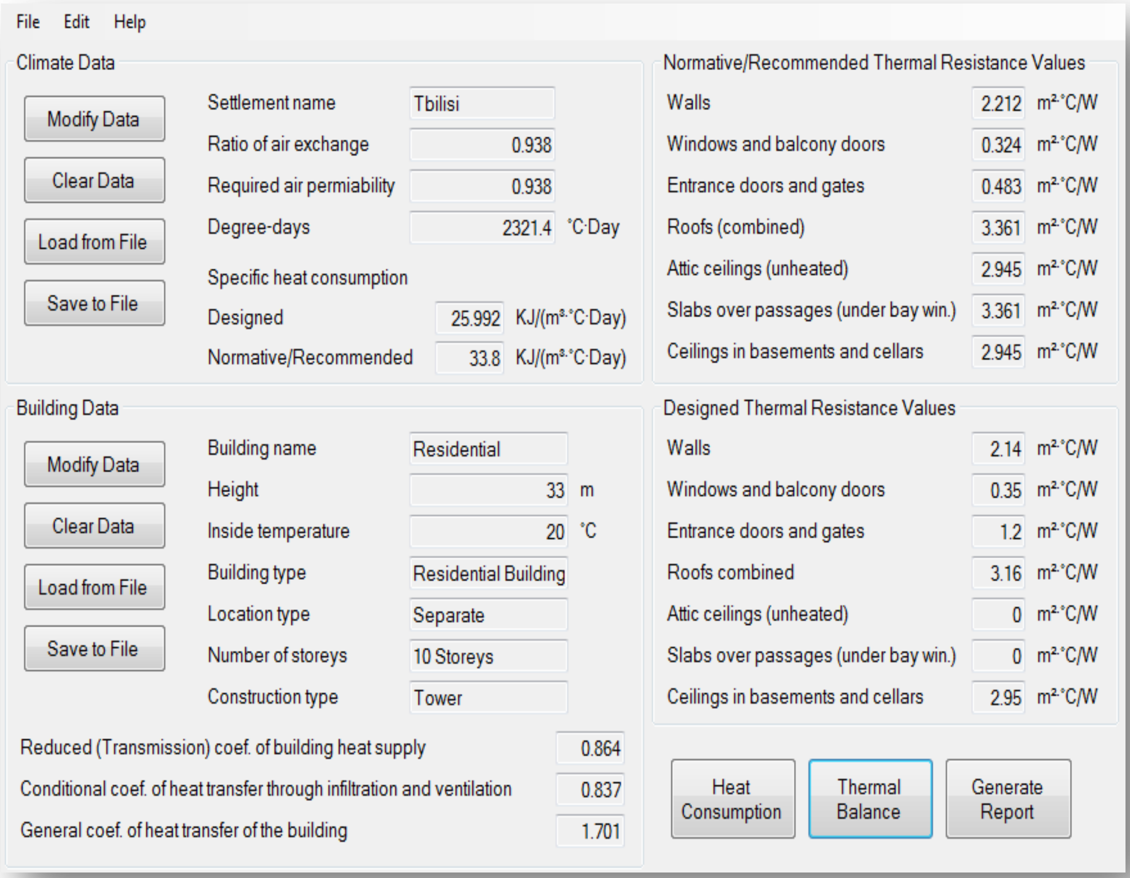
Georgia has not yet adopted advanced thermal engineering codes in compliance with the European Energy Performance of Buildings Directive (EPBD). An assessment of the current construction sector shows that there is great energy saving potential in the building sector, since an energy efficiency approach has not been implemented and the construction sector in Georgia mostly uses old Soviet building codes. [3]

The thermal performance design of a new residential building designed by the Georgian company "ARCI" was performed with the aid of the "Building Energy Passport" software tool. The calculation was performed for the overall thermal resistance value for walls constructed from 19x29x 39 cm perlite blocks, with a thickness of δ =29 cm. The figures for outdoor and indoor layers were calculated as follows: for an outdoor plaster layer - cement sandy mortar with δ=0.02 m, λ=0.93 W/m K; for indoor plaster – a complex mixture consisting of cement, sand and lime with proportions of δ=0.02m, λ=0.87 W/m K. In order to avoid thermal bridges in exterior walls joints were smoothed out with perlite cement mortar. The overall thermal resistance value – $\mathbf{R_{walls}}$ for walls from perlite blocks was $\mathbf{R_{walls}}$ **- 2.14 m** $\mathbf{^2}$ **K/W.**

Thermal resistance values for other exterior components have been selected and calculated in the same manner. Figure 6 presents the software screen with the results of thermal p performance design calculations performed by "Energy Passport" software. Figure 7 shows the thermal balance components that have been calculated by the software tool.

The results of the thermal performance design calculated with the integrated/advanced approach were compared with a prototype building designed with the old Soviet approach – an un-insulated house version that is, unfortunately, the current construction practice in Georgia. This un-insulated version has also been calculated by the Energy Passport software. A comparison of heat consumption results is shown in Figure 8.

Figure 6. The main software window showing calculations for a residential building developed by the company "ARCI"



Calculations show a 53% savings in heat consumption over the heating period, since R values of the un-insulated version are benchmarked by old Soviet codes and are very low. For instance, thermal resistance value for walls in the old system is $\mathbf{R_{walls} = 0.54\ m^2\ K/W}$, which is almost four times lower than the thermal resistance value -$\mathbf{R_{walls}}$ in the insulated version (Annex I).

Figure 7. Thermal balance chart with the calculated energy performance certificate section

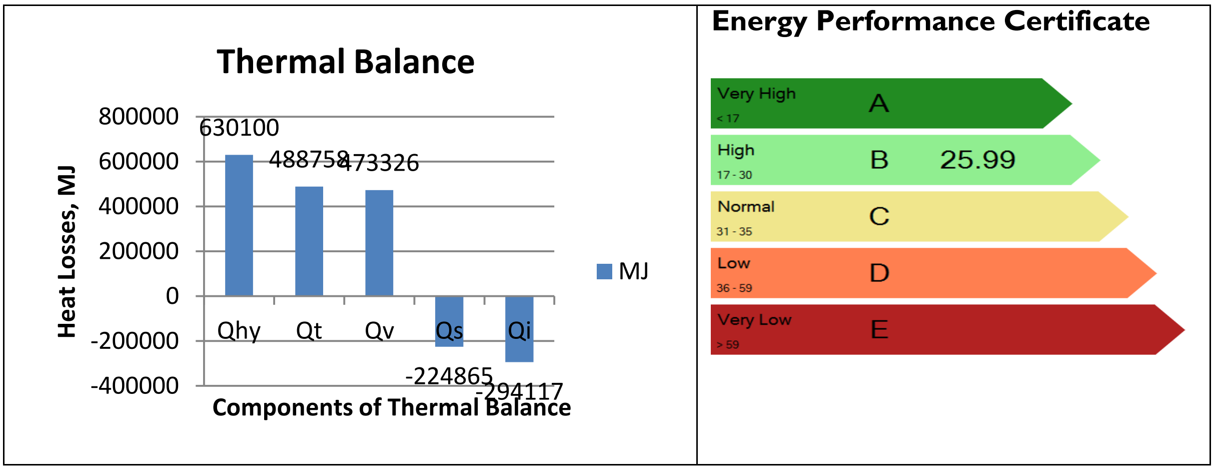
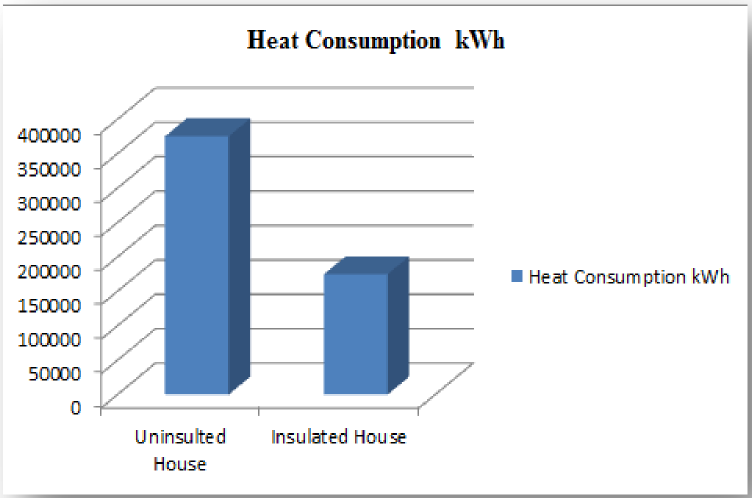


Figure 8. Heat consumption calculated by software tool for un-insulated and insulated prototype buildings



The "Energy Passport" software tool permits a quick assessment of building design with the thermal protection level during the design stage, and allows labeling with a wide selection of volumetric-planning indicators and thermal insulation solutions.

SECTION 3: COMPARISON OF THE DISPLAY® AND BUILDING ENERGY PASSPORT SOFTWARE CALCULATION TOOLS FOR LABELING EXISTING AND NEW BUILDINGS

3.1 EVIDENCE BASED APPROACH FOR THE USE OF THE DISPLAY® AND "BUILDING ENERGY PASSPORT" TOOLS FOR ENERGY PERFORMANCE LABELING

The GBC Georgia is responsible for the development of a voluntary green building certification/labeling scheme within the framework of the component 2–Green Building Rating and Certifying System, which is a part of the EC-LEDS Clean Energy Program implemented by the Winrock International administered by USAID. It has been planned for GBC Georgia to initiate labeling of existing non-residential buildings, of which the voluntary certification scheme and energy performance certification are indispensable parts.

The SDAP Center will develop an energy performance methodology that should lay down the foundation for further development of a building energy performance code in Georgia. It will be developed with requirements set up by the Spatial Planning and General Construction Code, which is a new Georgian regulation, expected to be adopted soon. It will also follow the requirements set out in Annex XXV of the Association Agreement between Georgia and the EU, dealing with the implementation of the EPBD in Georgia.

Within the scope of the work foreseen for the SDAP Center, assistance and advice to GBC Georgia on the energy performance certification scheme is envisaged; the scheme should be used for a green building rating and certification system to carry out labeling of existing non-residential buildings.

The EU experience shows that the EPBD provisions on energy performance certification of buildings have been implemented by Member States (MS), however different certification schemes have been used in the EU countries. This resulted from the adoption of mandatory regulations/technical requirements by MS that are based on the integrated energy efficiency concept in the building energy performance codes. In turn, energy performance certificates/labeling regulation depend on both adopted energy performance building codes and the methodology used for certification. The EPC itself represents a policy mechanism, since it advertises energy efficiency of a property for sale or for rent, and in this way influences decisions and general public awareness.

The certification process of *new buildings* in the Member States implies two approaches for implementation: certification at the planning/design stage (calculated rating) and certification after construction (operational rating). However countries didn't use a common approach-- some of them require both certificates and others only one. The main conclusion drawn from this certification process is that *the basic 7-step scale was foreseen as a means to cover all existing and new buildings.*

In parallel, as countries initiated the use of certification schemes, the Display® certification tool was introduced for existing public buildings on a voluntary basis. This tool gained popularity in many EU countries for labeling public buildings since it is user-friendly, and doesn't require in-depth professional knowledge. The software can be used by municipalities and especially by energy managers, as part of a campaign aiming to implement EPBD provisions for public buildings and develop local sustainable urban policies.

This software contributed to an understanding of the development of a new voluntary common EU certification scheme for non-residential buildings to address the issue of balancing national applicability and international comparability. This task is ongoing, and being considered within the framework of EPBD provisions implemented by Member States, especially provisions on the Nearly Zero Energy buildings, and is supported by the EU Commission.

Using the certification/labeling software at the building design/planning stages provides more opportunities to include factors that are usually impossible to incorporate into existing buildings--such as building geometry and its compactness coefficient, its location and orientation. It is important, however, particularly in respect to solar radiation and wind, the reduction of air permeability, the integration of passive design elements and other factors that can significantly contribute to reduction of energy consumption without enormous investment.

Thus, the SDAP Center has suggested that GBC Georgia use the Display® certification tool to certify existing buildings, since many of the innovative factors proposed by the "Building Energy Passport" software tool may be neutralized in the case of existing buildings and thus not particularly affect the labeling result. The Building Energy Passport is a professional program developed by the SDAP Center for integrated energy performance design for new buildings and for the assessment of energy consumption.

The SDAP Center strongly advises Georgian construction and development companies to use the Building Energy Passport software to meet the professional levels of energy performance design which is expected to become mandatory in the foreseeable future when buildings performance regulations are introduced. This software tool could be suggested for use as the national baseline for certifying new buildings within the context of new national energy performance regulations.

From conception to the final construction of a building, issues related to energy play an important role. The decisions made by architects, civil engineers and other design team members can have a significant impact on the long-term energy consumption of a building and the quality of its internal environment. The main advantage of the use of the Building Energy Passport is to support the building designers to assess the impact of new strategies and technologies efficiently and reliably during the building design process.

Comparing the labeling opportunities provided by the software tools such as: Display® and the Building Energy Passport for existing and new buildings makes it possible for the SDAP Center to advise GBC Georgia to use the Display® software tool for its tasks. The SDAP Center will provide a basic version of the user guide for energy performance certification of the existing buildings which adapts the online Display® software to the Georgian climatic conditions.

3.2 USER GUIDE FOR LABELING EXISTING BUILDINGS WITH THE ADAPTED DISPLAY® CALCULATION TOOL

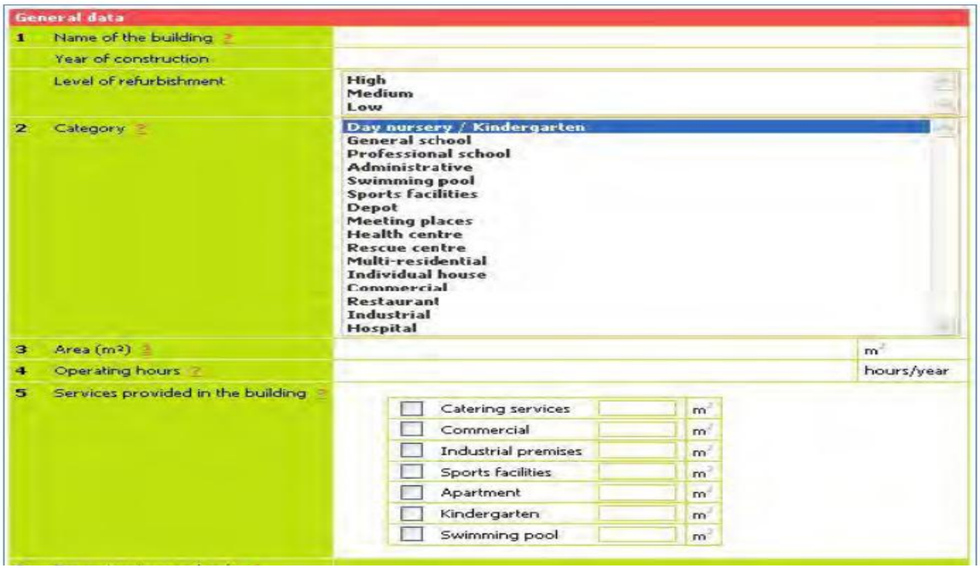
The official steps to use the Display® poster tool requires signing the Charter. After this the Energy Cities Association will send an invoice to allow registration and full access to the online software at the following link: http://www.display-europe.org/about840. Subsequently, for carrying out labeling it is important to enter and check all details on requested information such as: *My data, My Poster, My Organization* and *My translations* in the section: *My Account.* After *a* successful login to the program it transfers users to the "*Poster Edition*" section, then to the "*Buildings*" subsection. It opens the "*Manage your Building Data*" window with a group of tabs such as: "*List of buildings*", *"Make a calculation*" and "*Add a building*" (Figure 9). For adding a new building to the data base it is requested to enter a name of a building, its category, year of construction, anticipated level of refurbishment.

Figure 9. "Poster Edition "section of the program

Data on gross internal floor area is then entered, with operational hours and services provided in the building. The screen of the Display® software where information should be entered is illustrated in Figure 10. Data is entered according to the data form sheet explained in the Paragraph 1.3 of the report.

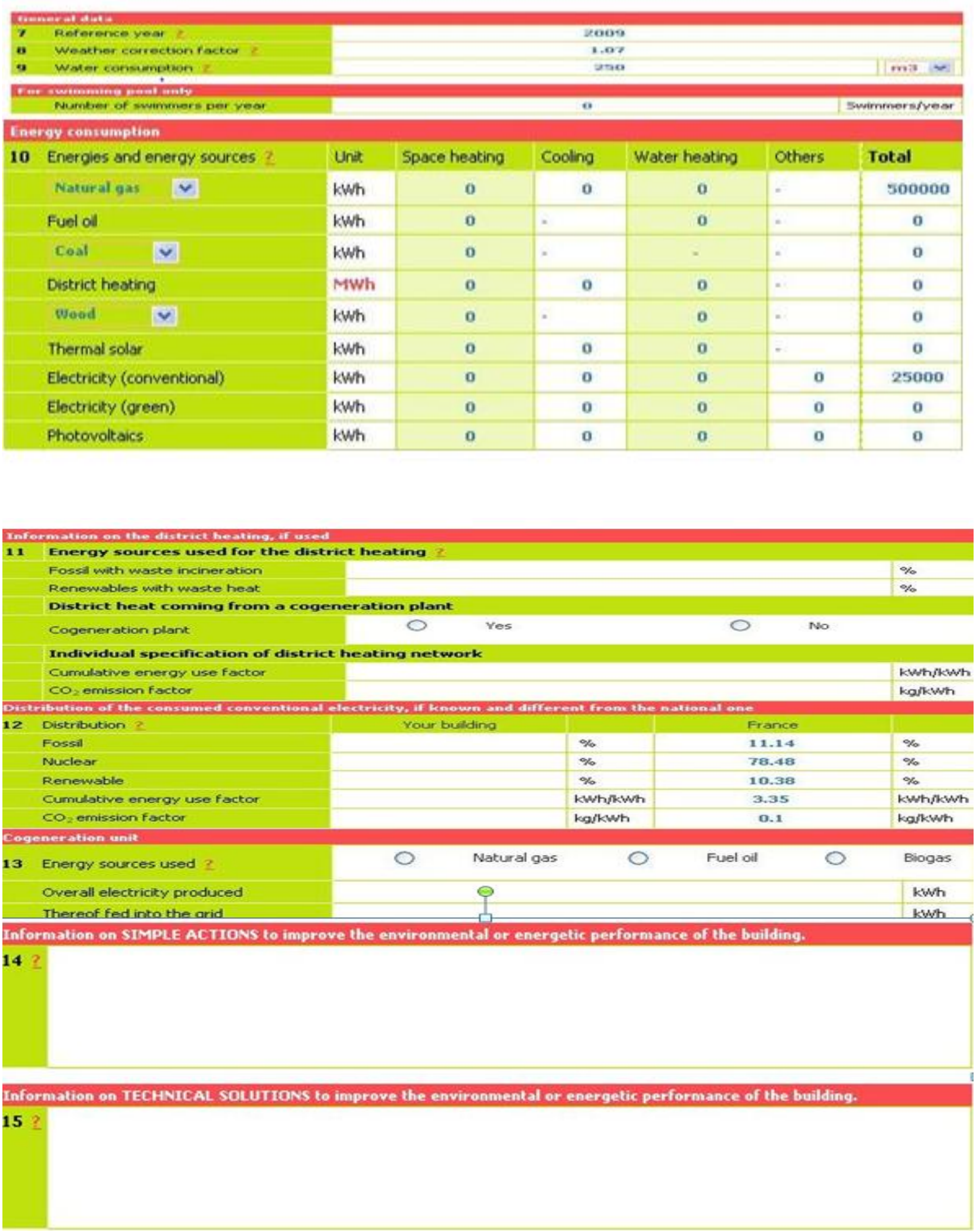
For anticipated rehabilitation work is necessary to mark the current level by selecting either low, medium or high, according to the current energy performance condition of the building. Low refers to only one of the following options completed in the building: insulated attic, insulated walls, renewed heating system and changed lighting, or controlled ventilation system installed. Medium refers to the insulated attic and two of the following: insulated walls, renewed heating system and lighting has been changed, or controlled ventilation system installed. High level is indicated by a complete refurbishment with all four factors.

Figure 10. Sub section for general data



After entering the requested information in the above subsection, the user moves to the next subsection: "*Posters*", and opens the *"Edit your Poster*" window with a group of tabs: "*List of Posters*", "*Make a calculation*", *"Download your poster*". To generate a poster relevant data on energy and water consumption are entered into the program window shown in Figure 11, according to the data given in the form in Paragraph 1.3 of this report.

Figure 11. Sub section for energy and water consumption data



General data			
7	Reference year ?	2009	
8	Weather correction factor ?	1.07	
9	Water consumption ?	250	m3
For swimming pool only			
	Number of swimmers per year	0	Swimmers/year

Energy consumption

10	Energies and energy sources ?	Unit	Space heating	Cooling	Water heating	Others	Total
	Natural gas	kWh	0	0	0	-	500000
	Fuel oil	kWh	0	-	0	-	0
	Coal	kWh	0	-	-	-	0
	District heating	MWh	0	0	0	-	0
	Wood	kWh	0	-	0	-	0
	Thermal solar	kWh	0	0	0	-	0
	Electricity (conventional)	kWh	0	0	0	0	25000
	Electricity (green)	kWh	0	0	0	0	0
	Photovoltaics	kWh	0	0	0	0	0

Information on the district heating, if used

11	**Energy sources used for the district heating** ?		
	Fossil with waste incineration		%
	Renewables with waste heat		%
	District heat coming from a cogeneration plant		
	Cogeneration plant	Yes	No
	Individual specification of district heating network		
	Cumulative energy use factor		kWh/kWh
	CO_2 emission factor		kg/kWh

Distribution of the consumed conventional electricity, if known and different from the national one

12	Distribution ?	Your building		France	
	Fossil		%	11.14	%
	Nuclear		%	78.48	%
	Renewable		%	10.38	%
	Cumulative energy use factor		kWh/kWh	3.35	kWh/kWh
	CO_2 emission factor		kg/kWh	0.1	kg/kWh

Cogeneration unit

13	Energy sources used ?	Natural gas	Fuel oil	Biogas	
	Overall electricity produced				kWh
	Thereof fed into the grid				kWh

Information on SIMPLE ACTIONS to improve the environmental or energetic performance of the building.

14 ?

Information on TECHNICAL SOLUTIONS to improve the environmental or energetic performance of the building.

15 ?

The reference year refers to the year when data will be used to generate a poster. The weather correction factor appears under "My Organization" tab and is automatically set in the building data sheets. For water consumption data the required unit is m^3, however there is an option to enter data in liters or gallons. These figures will be converted into m^3 by the calculation tool.

The Display® classification system is designed to assess 16 public building categories, yet it is also possible to assess mixed building types such as school buildings with a swimming pool or cafeteria, by making use of the "services" option. Having registered the general building data, the Display® user is able to edit a Display® poster by entering readily available information such as:

- annual (electricity) consumption for lighting and equipment in kWh,

- annual heating and hot water consumption in kWh,

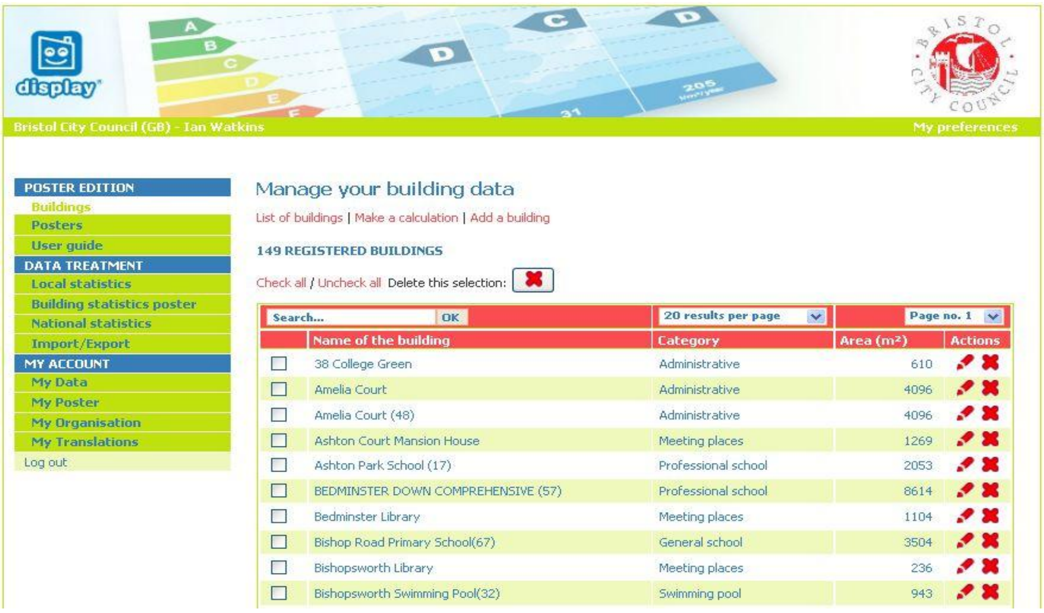
- annual water consumption in m^3.

The Display® software includes the most commonly available energy sources the building uses. These are gas (natural and liquefied), fuel oil, district heating, coal, biomass, solar thermal collectors, conventional electricity, certified green electricity, and photovoltaic installations on the building. Furthermore, cogeneration units in the building can be taken into account. If different energy supplies are used, it is possible to calculate an individual solution.

After having filled in all fields, data can be "saved". And a page "Results" gives the calculation of the data that will be shown on the poster. Starting from this page the Display® poster can be finalized by choosing the desired language. There is also an option to RESET, which doesn't take into account the modifications made before the document was saved. When the necessary information is available and entered, the Display® software works autonomously and immediately makes a printable poster available in PDF format. According to its building type, the building is graded into one of seven classes (A to G).

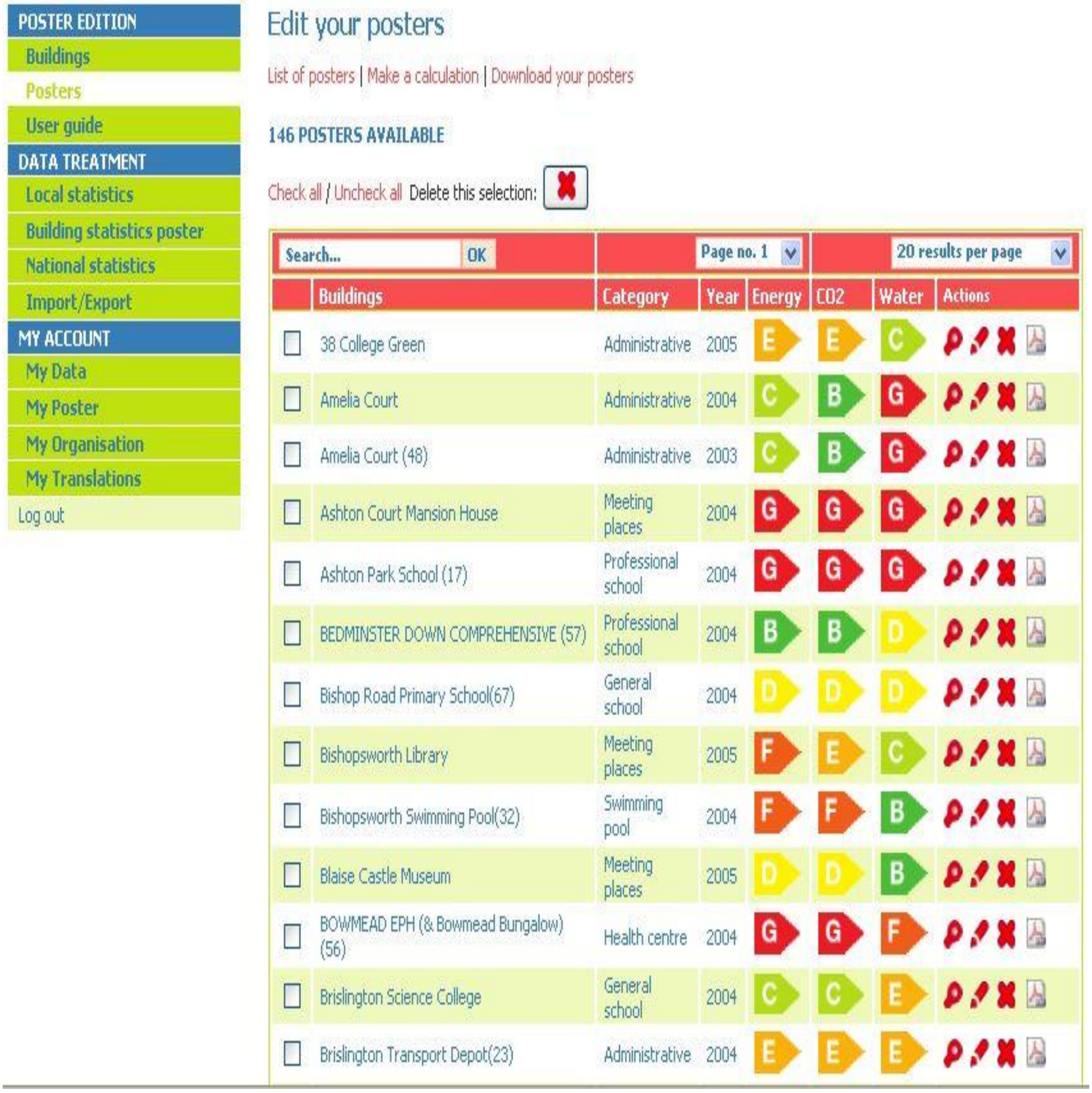
If it is necessary to change or correct information or to manage the data, it can be done by the tabs *"List of buildings"* or *"List of calculations"* (Figure 12 and 13).

Figure 12. List of registered buildings



The "List of buildings" provides the user with all information on a building and in the action part of the list there are two symbols, a pencil and a cross. If the user wants to edit data the pencil is chosen, and the cross is chosen to delete data. To change the water and energy data or add specific action to a poster one goes to the "*Posters*" section, "*List of calculations* "(Figure 13). Here it is possible to rank data by clicking on the table's column headings. As with the buildings section one can edit or delete the poster.

Figure 13. List of calculations



There is another symbol in the posters section, the magnifying glass. This symbol allows you to see your page with the summary of the results on your poster. It's also possible get a pdf version of the poster at this point, by clicking on the pdf symbol. If the preferred language has already been selected under "*My preferences*" it will open poster in that language. To see a summary of the results on a poster or download one in a different language, one can again click on the magnifying glass.

REFERENCES

1. Jan Turner, Peter Schilken. Leading by Example, Parliament Magazine, 4 April 2011.
2. Karine Melikidze. “Energy Passport” software program for designing enhanced thermal performance of the building envelope and energy efficiency labeling CISBAT 2013 Proceedings Vol. II – CLEANTECH for Smart Cities and Buildings pp.1121- 1126 http://infoscience.epfl.ch/record/190601
3. Y. Matrosov, K. Melikidze, N. Verulava. The energy efficiency perspective of the Georgian residential sector. http://www.sdap.ge/docs/microsoft_word_-_energy_efficiency_of_residential_sector.pdf

ANNEX 1:COMPARISON OF ENERGY PERFORMANCE CALCULATIONS FOR INSULATED AND UNINSULATED BUILDINGS

Thermal resistance values for exterior walls and windows: R_{wall} -m² C/W $R_{wind.}$ -m² C/W	Thermal resistance values for roof slab and floor on the ground: R_{roof} -m² C/W R_{floor}- m² C/W	*Qhy* - the overall consumption of energy: MJ (kWh)	Savings related to version 1 MJ (kWh)	Savings related to the uninsulated version (%)
Uninsulated version R_{wall}=0.54 R_{win}=0.35	R_{roof}=0.80 R_{floor}=1.6	1351279 (375355.3)	-	-
Insulated version R_{wall}=2.14 R_{win}=0.35	R_{roof}=3.16 R_{floor}=2.95	630101 (175028)	721176 (200327.3)	53.3